



## Transmission of STIs/HIV at the Partnership Level: Beyond Individual-Level Analyses

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**ABSTRACT** *Mathematical modeling of transmission dynamics of sexually transmitted infections (STIs) and HIV has considerably advanced HIV research by highlighting the importance of certain types of partnerships in epidemic spread. Notably, concurrent partnerships, defined as a sexual partnership in which one or more of the partnership members have other sexual partners while continuing sexual activity with the original partner, have been shown to play a fundamental role in potentiating the spread of STIs and HIV. Risk behaviors such as concurrency and sex without condoms as well as STI/HIV prevalence vary with physical, social, and emotional factors within partnerships. The efficiency of STI/HIV transmission appears to vary across types of concurrent partnerships according to the differing dynamics within them. Previous research on partnership dynamics has improved our understanding of the multidimensional aspects of sexual partnering, but little is understood of how these aspects of sexual partnering interact and increase risks for HIV, nor how types of partnerships, partnership dynamics, and concurrency work together to affect both the behavior of condom use and the biological transmission of disease. In this article, we discuss the need to extend our understanding of concurrency to include partnerships among men who have sex with men (MSM) and to differentiate between types of partnerships and to develop interventions to modify risk within partnerships. We also introduce a conceptual framework that reflects how individual and partner characteristics influence partnership dynamics that in turn influence risk behaviors, such as concurrency and not using condoms, and associated risks for STIs and HIV.*

**KEYWORDS** *Concurrency, Partnerships, STI/HIV, Sexual transmission dynamics, Bridging behaviors.*

### INTRODUCTION

Preventative and epidemiological research on HIV risk has advanced considerably by going beyond egocentric data on sexual behavior to include data from partners and even sexual networks. Mathematical modeling of transmission dynamics of epidemics of sexually transmitted infections (STIs), including HIV, has also highlighted the roles of certain types of sexual partnerships in epidemic spread. One such partnership, the concurrent partnership, is defined as a sexual partnership in which one or more of the partnership members have other sexual partners while continuing sexual activity with the original partner,<sup>1</sup> and has been shown to play

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a fundamental role in potentiating the epidemic spread of STIs such as chlamydial infections,<sup>2</sup> gonorrhea,<sup>3</sup> syphilis,<sup>1</sup> and HIV infection.<sup>4-6</sup> There is a need to better understand what goes on inside these partnerships to attenuate or aggravate disease transmission. To this point, partnership dynamics have been conceptualized and analyzed at the individual level as determinants of condom use, neglecting other aspects of partnership dynamics. Our previous research involved an in-depth qualitative study of partnership dynamics that developed a taxonomy of concurrent partnerships among heterosexuals. It also involved a longitudinal study assessing the relationships between partnership dynamics, formation and dissolution, condom use, concurrency, and STI incidence in partnerships<sup>7</sup> which suggests that the efficiency of STI/HIV transmission varies by partnership type.

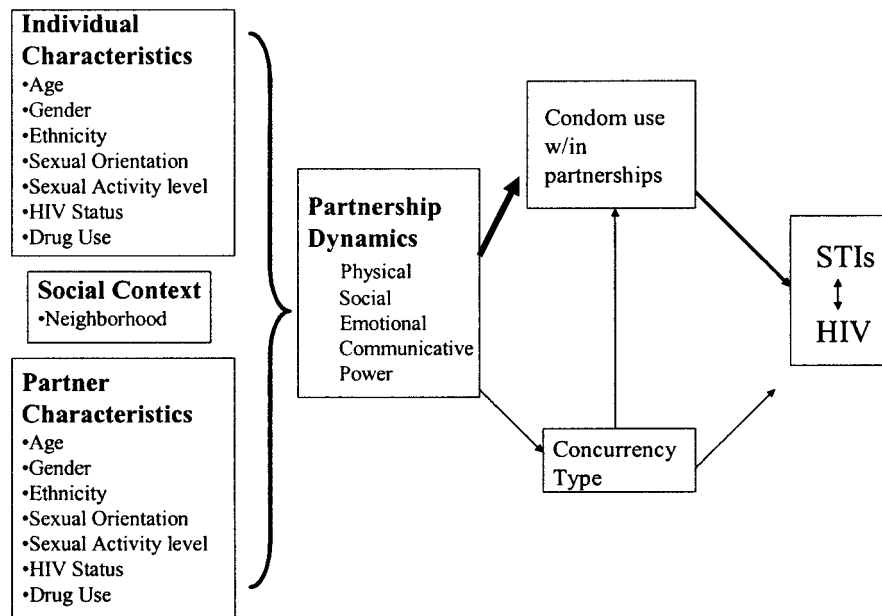
While tremendous advances have been made in research on sexual networks, methodological advances on sexual risk for HIV at the sexual partnership level have lagged behind. Research on sexual partnerships has suffered from two principal shortcomings: a lack of understanding of the dynamics within partnerships and the limited categories of types of partnerships studied. The HIV literature has relied on broad categorizations of partnerships as “main partner” or “regular partner” versus “casual partner,” with few attempts to define what is meant by these types. The benchmark study of sexuality in the United States, the National Health and Social Life Survey (NHSLS), described only four types of sexual partnerships: marriage, cohabitation, the intention of one or both partners to pursue the relationship further, and the explicit view by the partners of the relationship as short term.<sup>8</sup> The utility of these categories for HIV research is limited because they are based on a general sample of the United States and do not reflect potential partnership dynamics that may affect risk of HIV transmission (e.g., amount and type of sexual contact). The first shortcoming in research on partnerships is linked to the second: without a way to measure the dynamics within partnerships, it is not possible to differentiate between them. To date, research on partnership dynamics has focused on single aspects of relationships, including duration, exclusivity (or concurrency), emotional closeness (intimacy), communication, and power. Few if any studies have examined these dynamics simultaneously. A better understanding is needed of the variation of these dynamics across partnerships, as well as the way these dynamics interact to create or reduce risk for HIV. Most partnership dynamics have only been considered as predictive of condom use and not with other measures of risk behavior, such as having other partners in an ongoing partnership.

## **A CONCEPTUAL FRAMEWORK OF CHARACTERISTICS INFLUENCING PARTNERSHIP DYNAMICS**

In the Figure, we offer a conceptual framework that suggests individual and partner characteristics influence partnership dynamics, which in turn influence risk behaviors such as concurrency and condom use, and which are all ultimately associated with risk of HIV and other STIs. Below we review the elements included in this framework.

### **Emotional Closeness in Partnerships**

Within some partnerships, increased intimacy can make condom use more likely because it suggests greater comfort in negotiating behaviors. Condom use and partnership factors (mutual partner support and emotional closeness) have been associated with the likelihood that women would attempt to use condoms with main



**FIGURE.** Conceptual framework of partnership dynamics, concurrency type, and STI/HIV risk.

partners and in a cohabitation relationship; the belief that condoms build trust were also associated with long-term consistent condom use.<sup>9</sup> However, intimacy may also function as a barrier to condom use. For those in ongoing partnerships, nonuse of condoms has been associated with greater perceived relational intimacy.<sup>10</sup> Greater commitment has been associated with lower condom use,<sup>11</sup> and among HIV-discordant men who have sex with men (MSM),<sup>12,13</sup> using condoms can signify lack of closeness and trust. Clearly, intimacy operates along with other partnership dynamics to influence condom use; however, the relationship between the level of intimacy in a partnership and STI or HIV acquisition needs further study.

### Communication in Partnerships

Research on communication between partners and risk has focused mostly on communication about condom use but has rarely considered how communication affects other measures of sexual risk. Communication has been positively associated with consistent condom use among incarcerated adolescents,<sup>14</sup> although no significant difference in levels of reported condom use was found between respondents who reported talking about past sexual histories and those who talked specifically about HIV/AIDS protection.<sup>15</sup> It has also been suggested that belief in one's ability to communicate (communication self-efficacy) may increase the likelihood of condom use.<sup>16</sup> Because communication about condom use raises other issues in a partnership, some HIV serodiscordant MSM couples intentionally avoid communication about condoms because it is a reminder of the partner's positive serostatus.<sup>13</sup> Finally, poor communication in a partnership (both general sexual and health protective communication) has been associated with higher numbers of partners among adolescents.<sup>15</sup> In the research cited above, for example, communication in partnerships was studied at one point in time. The research did not consider how communication patterns may develop as intimacy grows in a partnership or, conversely,

as it dissolves. Communication skills, measured more generally as ability to discuss feelings and concerns within the partnership, need to be considered more fully in relation to other sexual risk behaviors.

### **Power Dynamics in Partnerships**

Power differentials in heterosexual sexual partnerships have been ascribed to gender.<sup>17</sup> Physical abuse and economic dependence are factors that affect the power dynamics in partnerships and may result in decreasing an individual's ability to adopt risk avoidance behaviors and protection from STI/HIV. Differences in power are thought to increase women's risk for HIV, especially among minorities and women who are economically and socially marginalized. A new psychometric instrument, the Sexual Relationship Power Scale (SRPS),<sup>18</sup> was developed for minority women based on the theory of gender and power<sup>17</sup> and the social exchange theory<sup>19</sup> to assess the association between relationship power and consistent condom use. Among Latina women with a primary sexual partner, a low score on the SRPS was associated with physical abuse and forced sex in the current relationship; a high SRPS was associated with consistent condom use and higher relationship satisfaction. The population-attributable risk estimate indicated that 52% of the lack of consistent condom use in this population of women could be attributed to low relationship power.<sup>18</sup> Because insistence on condom use may jeopardize the continued financial support by male partners of economically vulnerable minority women, their immediate needs may outweigh the risk of HIV infection.<sup>20</sup> The threat of domestic violence may also deter women from participating in STI/HIV control efforts such as partner notification.<sup>21</sup> Young African American women in abusive relationships were less likely than others to use condoms, were more fearful of asking their partners to use condoms, worried more about acquiring HIV, felt more isolated, and were more likely to experience verbal abuse, emotional abuse, or threats of physical abuse when they discussed condoms than were women not in abusive partnerships.<sup>22</sup> It is noteworthy that few studies have considered how males' economic dependence on female partners or on other males in homosexual relationships may affect condom use, as the assumption has been that it is females and not males that are vulnerable to relationship power differentials.

### **PARTNERSHIP TYPE AND CONDOM USE**

Perhaps the clearest designation of a type of partner is a new partner, although how long the partner is considered "new" is not standardized and is often left to be defined by respondents. Nevertheless, condom negotiation and use seem easier with new partners than with others; for college students, especially males, positive individual and relational outcomes, such as that the partner was more deserving of respect, less likely to have a STI, and more caring about them, were reported more for new partners who insisted on condom use than for those who did not.<sup>10</sup> In a prospective study of women in sexually transmitted disease (STD) clinics, 99% of women at 6-month follow-up reported sex with a regular partner, 33% also reported sex with a casual partner, and 27% also reported sex with a new partner; condom use was more common with new partners and casual partners than with regular partners. The pattern of condom use by partner type held when women with multiple partners were considered, using condoms more with new and casual partners than regular partners.<sup>23</sup>

Within ongoing partnerships, condom use may be more difficult. A population-

based survey of US adults found much more reporting of condom use with casual partners at last sex than with partners in an ongoing relationship (62% vs. 19%). After controlling for the type of relationship risk (injecting drug user, MSM, or HIV-infected partner), only 22% of persons at increased risk for HIV used condoms during last intercourse within an ongoing relationship. This suggests that nearly 80% of those with steady partners had a substantial risk of exposure to HIV.<sup>24</sup> Another study of women at high risk for HIV in six cities found that the most recent unprotected sexual encounter (without a condom) was more likely with a steady partner and less likely when the encounter was with a paying partner outside of their residence.<sup>25</sup> Why condom use is less likely in ongoing partnerships appears to be influenced by perceptions of the partners' attitudes. Among STD clinic patients, intentions for condom use with casual partners were influenced more by social norms for women and by personal attributes for men, but in steady partnerships, both men and women perceived their steady partners as less likely than casual partners to favor condoms. They seemed more concerned about a steady partner's norms concerning condoms than about casual partners' norms.<sup>26</sup>

Partnership type is associated with risky behaviors other than unprotected sex, such as substance use before sex. Female STD clients reported more risky behaviors (e.g., alcohol or drug use before sex, no condom use) with main partners than with casual partners, and men were more likely to use alcohol or drugs before sex with main partners than with casual partners, but not to engage in other risky behaviors. It is notable that 44% of the males and 76% of the females reported that their main partners also had other partners, an important implication for STI and HIV transmission.<sup>27</sup>

Condom use patterns within partnerships cannot be assumed to be static because partnerships themselves change over time. It appears that condom use is more likely to lapse than be adopted as a partnership continues. Among the few female STD patients followed prospectively whose relationships changed from new to regular partner, consistency of condom use decreased significantly.<sup>23</sup> Coital events among adolescents involved the use of condoms more often in new than in established relationships (66% vs. 54%), but condom use declined rapidly, so that levels were similar within three weeks from the establishment of the partnership.<sup>28</sup> Significantly more young African American women in San Francisco became inconsistent condom users than consistent condom users at 3-month follow-up, most likely because they formed new partnerships or had partnerships that evolved into more stable relationships over the study period.<sup>29</sup> An important consideration is that partners may not agree with each other on the type of partnership they are in. Among 162 partnership pairs at an STD clinic, there was poor agreement on type of partnership (regular or casual) and fair agreement on whether the partnership was new.<sup>30</sup>

## **PARTNERSHIP TYPES OF MSM**

Less research has been done on the partnerships of MSM than of heterosexuals, and the focus has been on the numbers of sexual partners among MSM who acquire or are at risk for STIs, including HIV. While research has documented that many MSM have short-term partnerships—a substantial proportion of which are even anonymous—these types of partnerships have often been lumped into one category: casual. The sexual partnerships of MSM are often identified by the venues where men meet or have sex such as circuit parties,<sup>31</sup> or locales such as public sex environ-

ments (PSEs) and commercial sex environments (CSEs),<sup>32</sup> and not by the more substantive or structural features of the partnerships. Partnership type has also come to be identified for MSM by serostatus of the partner, that is, serostatus concordant, serostatus negative, or serostatus unknown, again ignoring the dynamics within these partnerships. Notably, although not explicitly studied, many MSM have concurrent partnerships; almost half the MSM with gonorrhea in Seattle had a primary partner, and most acknowledged additional and anonymous partners recruited from venues such as sex clubs, parks, or the Internet, and reported unprotected anal intercourse (UAI) with all partner types.<sup>33</sup> There is a need to expand and refine definitions of sexual partnerships of MSM and to measure concurrency as well as multiple sex partners among MSM. While the above research has compared behavioral differences by partnership type (e.g., amount of UAI), a better understanding is needed of the differences in communication, power dynamics, and intimacy between partnership types of MSM.

As with heterosexuals, MSM may practice protected sexual activity (condom use) with new and short-term partners more frequently than with ongoing partners, making established partnerships, if serodiscordant, potentially more risky for HIV transmission. A study of MSM in primary relationships on the West Coast found higher risk behavior among men with “boyfriend relationships” than among men without such partnerships; 51% versus 21% had UAI in the last two months, although 34% of those having UAI with the primary partner did not know the partner’s HIV status, and a total of 44% did not know either their own or their partner’s HIV status.<sup>34</sup> Another study reported that 36% of men had not consistently used a condom in the last 6 months; 73% of those men were not using condoms with a steady partner, but 27% reported doing so with a casual partner.<sup>35</sup> Condom use has also been reported as lower among MSM partnerships that are considered “primary” than among those that are not, especially insertive UAI (46% versus 23%).<sup>36</sup> These behaviors have been linked to HIV acquisition; an ongoing or primary partner was reported to be the source in 50% of cases of seroconversion in a cohort of young men in Amsterdam<sup>37</sup>; however, no independent confirmation of the source of infection was obtained, and many index cases reported multiple partners. In a study of 3,257 seronegative MSM in six cities, condom use was found to be significantly lower among men in a primary relationship with a single partner known or thought to be HIV-seronegative than among other men (52% vs. 14% never used condoms during receptive anal sex; 30% vs. 57% always used).<sup>38</sup>

UAI does not always represent risk within a partnership if it occurs within a “negotiated safety” agreement in which both men are seronegative and comply with an arrangement in which they only have UAI with each other.<sup>39</sup> However, compliance with such negotiated agreements is not always consistent; therefore, risk may not be static and may not remain low.<sup>40</sup> In the San Francisco Men’s Health Study, HIV-positive men in a primary relationship were less likely to be monogamous than HIV-negative men; over 40% of these men were in a primary relationship and over 50% reported their relationship to be nonmonogamous.<sup>41</sup> Additionally, management of this risk within the partnership requires both partners knowing and sharing their HIV status with each other; however, many MSM do not know their own or their partners’ status—even those in primary relationships. In one large study in Switzerland, only 52% of steady partners knew each other’s status.<sup>42</sup> Another study found that, although the men with primary partners reported higher UAI than men without primary partners, only a quarter of those primary partnerships were reported as monogamous.<sup>36</sup> Compliance with such negotiated safety

agreements among MSM appear to be affected by the same partnership dynamics as those described above for heterosexuals.

### CONCURRENT SEXUAL PARTNERSHIPS

In modeling transmission of infectious diseases in populations, concurrent partnerships clearly potentiate the epidemic spread of STIs. In Colorado Springs, the most powerful influence on an individual's likelihood of transmission of chlamydia was concurrency<sup>2</sup>; similar findings were reported for gonorrhea.<sup>3</sup> Much of the previous research on concurrent partnerships has involved mathematical modeling using hypothetical data because, until recently, empirical data on concurrency were limited. For example, the contribution of concurrent partnerships to the spread of HIV was suggested to be as statistically important as that of multiple partners and the spread of cofactor infections,<sup>6</sup> influencing not only the rapidity of spread of HIV in the initial epidemic phase but also the total number of individuals who become infected.<sup>5</sup> Yet recent data collected on concurrency and HIV from five urban communities in sub-Saharan Africa did not show that concurrency, or the estimated fraction of sexual partnerships concurrent at the time of the interview, varied by HIV prevalence across cities or between HIV-infected and uninfected people.<sup>43</sup> While this study provides important data that questions the role of concurrency in driving HIV epidemics, it is limited by temporal ambiguity, thereby associating current sexual behavior with a disease that may have been acquired years earlier. Studies are needed that connect current sexual behavior to recent acquisition of HIV to clarify the role of concurrency in HIV epidemics.

Empirical data on concurrency are being collected and reported more often today than ever before. These data demonstrate that concurrent relationships are common among adolescents,<sup>44</sup> women, and STD clinic patients. In the National Longitudinal Study of Adolescent Health, more than half of the 56% of the sample that reported more than two partners also reported concurrency.<sup>45</sup> In the National Survey of Family Growth, approximately 25% of US women 15 to 44 years of age with more than two partners,<sup>46</sup> and 12% of all women,<sup>47</sup> reported concurrent sex partners. In Seattle, when asked directly if they had had any other partners during their sexual relationship with their most recent partner (multiple concurrent partners), 27% of men and 18% of women reported concurrent partners.<sup>48</sup> In the context of concurrency, sexual bridging contributes to the movement of STI/HIV epidemics from those with high-risk behaviors to those with lower risks. Among STD patients in the United States who practiced sexual bridging behaviors, "active bridgers" were those infected with an STI, and "potential bridgers" were those who were uninfected.<sup>49</sup> Bridging partnerships are often concurrent, although the proportions of bridgers that are concurrent and the fraction of concurrent partnerships that allow bridging in networks has not been measured. Nevertheless, these surveys of concurrency and bridging behavior suggest great regional and sociocultural variations in the nature of concurrency itself. Different patterns of concurrency have different implications for the efficiency of STI transmission across populations. Our empirical study of concurrency used qualitative data to describe a range of different types of concurrent partnerships with differing levels of condom use, frequency of sex, and type of sex.<sup>50</sup> The important themes that emerged from that work, on concurrent partnerships, differences in types of concurrency, and motivations for concurrency, now require validation through quantitative studies. More-

over, quantitative research will be needed to determine the distribution of specific types of concurrent partnerships and how they may vary by sexual orientation.

## CONCLUSIONS

Measures of the sexual risk within partnerships (e.g., amount of sexual contact, sexual practices including condom use) have not been incorporated into sexual network models. Instead, sexual networks are typically described by their density; that is, by the number of partnerships within them and the number of those that are concurrent. Yet the potential contribution of sexual networks to infectious disease transmission may vary not only by network size but also by other sexual behaviors occurring within the network. Research that includes in-depth descriptions of partnership types and risk behaviors within networks and that measures and characterizes numbers of sexual contacts would help to advance understanding of sexual networks and models. One example of this is research on bridge persons who have sex with members of both high-risk and low-risk groups, or with individuals from groups that have high and low STI/HIV prevalence.<sup>51</sup> Transmission in a network is accelerated when such bridging occurs within concurrent sex partnerships.

Expanding the concept of risk from a focus on the individual to one on partnerships can help to improve understanding of both behavior and disease. This is because the risk of acquiring STIs/HIV for the individual results from not only his or her own concurrent partnerships and behaviors but also from his or her partner's practice of concurrency. An individual's partner may have concurrent partners who belong to high STI/HIV-prevalence sexual networks, which may inadvertently increase the risk of infection to the individual who is several steps removed from the high-risk networks.<sup>52</sup> Risk varies both within and across partnership types over time; however, the association between such variation and HIV acquisition has not yet been clarified. To improve understanding of the transmission dynamics that drive HIV epidemics, studies of risk groups such as MSM should include measures of partnership dynamics, such as level of communication, intimacy, power dynamics, concurrency, and condom use (Figure). Such research would help to clarify how partnerships vary within sexual networks, how risk behaviors vary within partnership types, and how the intersection of risky partnership types and sexual networks is associated with STI/HIV disease transmission.

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